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Empirical Evidence from US Bank Holding Companies**

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Does Securitization Reduce Credit Risk Taking? Empirical Evidence from US Bank Holding Companies

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Abstract

This study investigates the impact of securitization on the credit-risk taking behavior of banks. Using US bank holding company data from 2001 to 2007 we find that banks with a greater balance of outstanding securitized assets choose asset portfolios of lower credit risk. Examining securitizations by the type of underlying assets we find that the negative relationship between outstanding securitization and risk taking is primarily driven by securitizations of mortgages and home equity lines of credit. Securitizations of all other types of assets, on the other hand, seem to have no significant impact on bank credit-risk taking behavior. We attribute these results to the recourse commonly provided in securitization transactions that might alter the risk-taking appetite of the issuing banks across asset classes. Therefore, we conclude that the net impact of securitization on the risk-taking behavior of issuing banks, and consequently on the soundness of the banking system, is ambiguous and will depend on the transactions structure. In particular, it will depend on the relative magnitude of credit support provided by banks. This leads us to suggest that banks have typically viewed securitization as a financing rather than a risk management mechanism.

Keywords: bank; securitization; risk taking

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1 Introduction

In the two decades leading up to the recent financial crisis banks have been operating in increasingly competitive markets, and as such have been forced to take on more risks and to seek out higher margins activities. Securitization has facilitated this desire for higher margin business, by allowing banks to convert illiquid loans into marketable securities and therefore to release capital for other investment opportunities. The increasing volume of securitization activity in the run up to the financial crisis raised the concerns of researchers as well as those of analysts, investors and regulators over the potential for an increase in systemic risk.¹

In general, previous empirical studies of the impact of securitization on issuing banks have suggested a positive link between securitization and bank risk.² By allowing banks to convert illiquid assets into liquid funds, it has been argued that securitization may well increase the expansion of credit and cause banks to hold riskier assets. The existing literature on the former issue shows that securitization reduces the influence of a bank's financial condition on credit supply (Loutskina and Strahan, 2006). However, little evidence has been collected on how securitization affects banks' willingness to increase the proportion of risky assets in their portfolios.

Since securitization provides banks with an additional source of loan financing and liquidity, it might motivate them to shift their portfolios towards higher risk/return assets (Cebenoyan and Strahan, 2004; Purnanandam, 2009). However, typically issuing banks retain first-loss contractual interests and/or provide implicit recourse in securitizations. These arrangements mean that the risks inherent in the securitized assets have not been transferred to investors and are, in effect, still held by the issuing bank, but off-balance-sheet (Risk Management Credit Card Securitization Manual, 2007; Calomiris and Mason,

2004; Chen *et al.*, 2008; Higgins and Mason, 2004; Niu and Richardson, 2006; Vermilyea *et al.*, 2008).

Therefore outstanding securitization exposes the issuing bank to the credit risk associated with the transferred assets. Assuming that the risk exposure arising from the securitized pool is understood by the bank, we hypothesize that this should have an impact on its risk-taking behavior. In particular, greater outstanding securitization, and therefore greater credit risk exposure arising from the pool, should make banks more risk-averse and motivate them to shift their portfolios towards assets of lower credit risk.

This study aims to contribute to the existing literature by assessing the impact of securitization on the credit-risk taking behavior of US bank holding companies. We first examine whether the aggregate outstanding securitization affects banks' risk-taking behavior. Second, we test whether the effect differs across securitizations of different asset classes using new data on banks' securitization activities mandated by changes to regulatory reports in 2001.

Our results show that bank credit-risk taking behavior is negatively associated with securitization, suggesting that banks with a greater balance of securitized assets outstanding choose asset portfolios of lower risk. Examining securitizations by type of underlying asset reveals that the negative relationship between outstanding securitization and risk taking is primarily driven by securitizations of mortgages and home equity lines of credit. Securitizations of all other types of assets, on the other hand, seem to have no significant impact on bank credit-risk taking behavior. We explain these results with reference to the "recourse hypothesis", that is, the credit risk retained by the issuing banks in connection to the securitized assets, through the recourse explicitly and/or implicitly provided in securitization transactions.

The remainder of this paper is organized as follows: Section 2 provides a brief review of relevant literature; Section 3 describes data and provides brief descriptive statistics of the sample; the empirical specification is presented in Section 4, while Section 5 reports results of the analysis; finally, Section 6 discusses the findings and concludes the paper.

2 Literature Review

Securitization occurs when a bank transforms its illiquid assets, traditionally held until maturity, into marketable securities. In a typical securitization transaction the originating bank transfers a pool of financial assets with fixed or nearly fixed cash flows to a special purpose vehicle (SPV), a bankruptcy-remote entity that in turn finances the purchase through the issuance of securities backed by the pool. The transfer of assets must qualify as a “true sale”, where the transferor (i.e., the originating bank) surrenders control over the financial assets and can therefore remove the assets from its balance sheet.

To reduce credit risk for investors, thereby increasing the credit rating of the asset-backed securities, and to mitigate adverse selection problems arising from issuers having superior information about the credit quality of underlying assets than do the investors, the SPV obtains credit enhancements. These enhancements typically come from the originating bank and can include both contractual and non-contractual arrangements. Examples of contractual arrangements, or explicit recourse, include retaining interests in the transferred assets such as credit-enhancing interest-only strips and subordinated securities, and providing standby letters of credit to the securitization structures. Non-contractual arrangements, or the so called implicit recourse, include: (i) selling assets to the SPV at a discount from the price specified in the securitization documents; (ii) purchasing assets from the SPV at an amount greater than fair value; (iii) exchanging performing assets for non-performing assets in the SPV; and (iv) funding credit

enhancements beyond contractual requirements.³ The provision of implicit recourse violates the “true sale” condition; however, it allows issuers to maintain their reputations for consistent credit quality over repeated sales.

Early theoretical work suggests that securitization provides a means of reducing bank risk (Greenbaum and Thakor, 1987; Pavel and Phillis, 1987; Hess and Smith, 1988). Later research investigated the effect that securitization had on bank risk from several perspectives and has reached mixed conclusions. This later research has focused on three broad themes: the quality of the assets securitized or retained; recourse arrangements; and the impact on overall bank risk.

Cantor and Rouyer (2000) argue that the credit risk position of the issuer improves if the riskiness of the securities sold to investors is higher than that of the issuer prior to the securitization; otherwise the transaction might intensify the issuer’s net exposure to the default risk of its assets. Ambrose *et al.* (2004) find evidence to suggest that, in response to regulatory capital incentives, lenders tend to retain riskier loans in their portfolios while selling safer loans to the secondary market. Contradictory evidence is found by Carey (1998); this study shows that the default rates on the loans kept by the issuer are lower than the default rates on the loans sold to other investors. Similarly, recent studies by Dell’Ariccia *et al.* (2009), Mian and Sufi (2009) and Keys *et al.* (2010) find evidence that in the last decade US banks securitized their worst mortgage loans.

The second issue addressed by the literature relates to the recourse commonly provided by the originating bank. In particular, Gorton and Pennacchi (1995) argue that originating banks retain a portion of the securitized loans on the balance sheet, or offer an implicit guarantee, to reduce moral hazard problems as in these cases there still remains an incentive to evaluate and monitor the borrowers. Chen *et al.* (2008) find that banks’ retained interests vary by type of securitization and are relatively low in the case of

mortgages, while relatively high for revolving loans such as credit card receivables. Calomiris and Mason (2004) find that in credit card securitizations risk remains with the securitizing banks as a result of implicit recourse. Vermilyea *et al.* (2008) also find evidence of implicit recourse in credit card securitizations, where banks with poorly performing securitization portfolios claim higher fraud losses. Beneficial effects of recourse are found by Higgins and Mason (2004) in the form of increased short- and long-term stock returns and improved long-term performance; this evidence is consistent with that of Gorton and Souleles (2005), who find that market prices of asset-backed securities reflect the originator's ability to provide recourse.

Finally, a few authors have analyzed the effect of securitization on overall bank risk. Dionne and Harchaoui (2003) find a positive association between securitization and bank credit risk. Franke and Krahn (2005) and Haensel and Krahn (2007) find evidence that the issue of collateralized debt obligations increases the systematic risk of the issuing bank. Jiangli and Pritsker (2008), on the other hand, find that mortgage securitization reduces bank insolvency risk and suggest a positive role for securitization relating the current turmoil in mortgage credit and securitization markets to recent excesses in those markets. Cebenoyan and Strahan (2004) also find evidence to suggest that securitization reduces bank risk; however banks use the achieved risk reduction to take on new risks. Purnanandam (2009) also provides evidence to show that banks use the proceeds from securitizations to issue loans with higher than average default risk.

3 Data and Descriptive Statistics

3.1 Data and Sample Selection

To study the effect of securitization on bank credit-risk taking behavior we use US Bank Holding Company (BHC) Data from Y-9C forms, which are filed on a quarterly basis by all BHCs and have been compiled in a data set by the Federal Reserve Bank of Chicago

since 1986. We use data for bank holding companies rather than for commercial banks because risk and capital management are typically administered at the highest level of the financial group. In addition, securitization may involve several subsidiaries of a BHC and affect capital and liquidity planning for the whole group.⁴

The Y-9C reports collate basic financial data from banks on a consolidated basis in the form of a balance sheet, an income statement, and detailed supporting schedules, including a schedule of off-balance-sheet items. Since June 2001, US banks have been required to provide more detailed information on their securitization activities in their regulatory forms.⁵ The incorporation of the new data into FR Y-9C determines the start date of the sample period, which yields 27 quarters from the second quarter of 2001 to the fourth quarter of 2007.

When constructing the data set we excluded banks with missing information on total assets, total loans, capital, and securitization activities for any quarter of the sample period. When banks go through a merger or acquisition we maintain the code of the acquiring BHC while the acquired bank is eliminated from the sample. To prevent the possibility of outliers driving the results, we exclude all bank-quarters with asset growth over the last quarter exceeding 50% and loan growth exceeding 100%. We also exclude banks in any quarters for which total loans-to-asset ratio is less than 0.1, or loan-to-deposit ratio exceeds 10. The final data set contains 42,685 bank-quarters for 2,190 BHCs.

3.2 Descriptive Statistics

Before turning to the main analysis, we compare securitizers and non-securitizers along five dimensions: (i) balance sheet structure; (ii) loan portfolio; (iii) regulatory capital; (iv) risk; and (v) operating performance.⁶ Given that securitization is a recurring activity, we assign a bank to the group of securitizers if we observe securitization activity in any quarter of the bank's lifetime in the sample. This yields 230 securitizers and 1,960 non-

securitizers in total for the period from 2001:Q2 to 2007:Q4. We use the quarterly data to calculate the time-series averages for each BHC and then compare the averages in cross-sectional tests. The results of these comparisons are presented in Table 1, where we report means and standard deviations for all banks, securitizers and non-securitizers, and the difference in means between the latter two with its statistical significance.

Looking at the first panel of Table 1, the average amount of total assets for the sample BHCs is \$5.3 billion. This is the most significant difference between securitizers and non-securitizers; the mean value of total assets for securitizers (\$41billion) is approximately 41 times the mean size of non-securitizers (\$1 billion). This finding is consistent with previous research that documents that larger banks are more likely to securitize.⁷ Further, securitizers tend to hold less liquid assets (0.25% versus 0.27% of total assets), which is consistent with having a better access to external funding and thus needing a smaller liquidity buffer compared to non-securitizers. Originated loans on average constitute 66% of BHC's total assets with no significant difference between securitizers and non-securitizers.

We turn next to the liability side of the balance sheet. Both securitizers and non-securitizers are mainly financed by deposits. However non-securitizers rely on this source of funding to a larger extent (69% of total assets versus 62%). The capitalization of the sample BHCs constitutes 9% with no distinguishable difference between securitizers and non-securitizers. The proportion of loans to deposits is significantly higher for securitizers (1.12 versus 0.98).

The second panel of Table 1 contains information on bank loan portfolios. The securitizers' loan portfolio is different in terms of both concentration and composition. In particular, it tends to be more diversified, as indicated by the Herfindahl-Hirschman Index (HHI) of 0.56 versus 0.59 for non-securitizers.⁸ Further, securitizers tend to hold

significantly less real estate loans (67% versus 71%)⁹ while keeping more consumer (10% versus 8%) and other loans (7% versus 5%) on the balance sheet.

Looking at the regulatory capital, one can see that the sample BHCs are on average overcapitalized (e.g., 14.8% for the total risk-based capital ratio). Comparing securitizers and non-securitizers, we find that securitizers are less capitalized than non-securitizers on the risk-adjusted basis; however the difference is not statistically significant. This is consistent with Cebenoyan and Strahan (2004) and Minton *et al.* (2008), who find that banks that are engaged in credit risk management tend to hold less capital.

Further we consider four risk characteristics of the banks: (i) risk-weighted assets relative to total assets; (ii) non-performing loans¹⁰; (iii) charge-offs¹¹; and (iv) loan loss provisions. For the average BHC in the sample, the non-performing loans and charge-offs constitute 0.9% and 0.3% of total loans, respectively. The loan loss provisions constitute 0.4% relative to total loans. Comparing securitizers and non-securitizers, we find that securitizers are more risky according to all the measures used with the differences being both economically and statistically significant. Similar results are found by Jiangli and Pritsker (2008) and Minton *et al.* (2008) with provision, charge-off and non-performing loan ratios higher for securitizers.¹²

Finally, we compare performance measures. The results suggest that securitizers have a higher return on assets compared to non-securitizers (1.2% versus 1.1%) with the difference being statistically significant. As for the revenue structure, the interest income constitutes the main source of revenue for both securitizers and non-securitizers (over 70%); however concentration across the sources is lower for securitizers (two-part revenue HHI of 0.64 versus 0.7 for non-securitizers) due to a higher share of non-interest income in their net operating revenue (29% versus 20% for non-securitizers). The latter is

consistent with securitizers having an additional source of income in the form of servicing fees and possibly more trading revenue.¹³

Taken together, these comparisons suggest that securitizers improve their profitability through holding riskier and hence more profitable loans in their portfolios and earning a higher share of revenue from non-interest income.

The last panel of Table 1 reports statistics on securitization activities of the banks. The average amount of outstanding securitized assets equals 14.4% of bank's total loans, or 8.4% of total assets. The contractual credit enhancements provided by the banks to securitization structures constitute, on average, 6.8% of securitized assets, or 0.3% of bank's total assets; these include credit-enhancing interest-only strips, subordinated securities and other residual interests, and standby letters of credit.

Figure 1 shows the volume of outstanding balances of securitization broken down into asset-backed and mortgage-backed securitization for year-ends 2001-2007.¹⁴ It illustrates a general upward trend in total securitization over the 2001-2007 period; with slight downturns in 2003 and 2007. It is worth noting that the value of securitized mortgages has been fluctuating over the period in general with the maximum amount of around \$1.37 trillion reached at the year-end 2006. However the value of asset-backed securitization has been growing steadily throughout the period, with the maximum value of \$614 billion reached at year-end 2007 during the crisis of the US subprime mortgage markets.

Figure 2 presents a detailed breakdown of securitization by asset type. It shows that mortgage-backed securitization makes up the majority (i.e., 65%) of total securitizations. All other loans and leases and credit card receivables, being major classes in asset-backed securitization, constitute merely 10% each in total securitization.

As for commercial and industrial loans, auto loans, home equity lines of credit and other consumer loans, their shares are relatively low and amount to 2-5% of total securitization.

4 Empirical Specification

We now turn to the empirical analysis to test whether outstanding securitization has an impact on the risk-taking behavior of the issuing bank. Our empirical model includes a number of control variables for bank characteristics and activities, which may influence bank risk-taking propensity or aversion (see for example Dionne and Harchaoui, 2003; Uzun and Webb, 2007; and Stiroh, 2006). In addition to the bank-specific characteristics, we include GDP to control for macroeconomic effects; while time effects are captured by introducing quarter dummies.

The basic regression is:

$$\Delta CrR_{i,t} = \alpha_i + \beta_1 Sec_{i,t-1} + \beta_2 Size_{i,t-1} + \gamma' Z_{i,t-1} + \phi' GDPG_t + \theta' Quarter_t + \varepsilon_{i,t} \quad (1)$$

where β , γ , ϕ , and θ reflect the extent to which the relative factor of the model contributes to the change in the dependent variable, and $\varepsilon_{i,t}$ represents the error term for bank i in quarter t . The dependent variable, $\Delta CrR_{i,t}$, is the change in the credit risk of bank i 's portfolio in period t ; $Sec_{i,t-1}$ is securitization; $Size_{i,t-1}$ is bank size; and $Z_{i,t-1}$ is a vector of additional bank-specific characteristics. The timing applied in this model is to ensure that the direction of causality goes from the explanatory variables to the dependent variable (Demsetz and Strahan, 1997; Stiroh, 2006). The detailed construction of the model variables and their expected signs are presented in Table 2.

Following Avery and Berger (1990), Shrieves and Dahl (1992), Berger and Udell (1994), Berger (1995), and Aggarwal and Jacques (2001), we primarily measure credit risk of a bank's portfolio (CrR) using a ratio of risk-weighted assets to total assets ($RWATA$).¹⁵ Shrieves and Dahl (1992) suggest that the risk-weighted assets to total asset ratio

captures two principal features of a bank's portfolio risk, i.e., its allocation of assets across risk categories and the quality of its loans. Further, Avery and Berger (1990) show that the relative risk weights used in the framework of the risk-based capital standards correlate with risky behavior and have an adequate informational value in predicting future bank performance problems, such as portfolio losses and bank failures.

Kim and Santomero (1988) argue that banks might be prompted to shift to more risky assets by inefficiencies in regulatory capital requirements. According to this argument, bank risk increases due to the low quality of assets left on the balance sheet while regulatory capital requirements remain unchanged, a process commonly referred to as regulatory capital arbitrage. However, this study is different in terms of covering the period of the development process of Basel II, which aligns more closely regulatory capital charges on banks' assets, including securitization positions, and the underlying credit risk. As remarked by Randall S. Kroszner, a member of the Board of Governors of Federal Reserve System, on July 12 2007, there has been "significant progress in risk measurement and management at many banks in the United States and elsewhere as a result of the Basel II development process".¹⁶ Therefore we hope to find results on the effect of securitization on bank risk-taking behavior less biased by regulatory capital arbitrage.

Securitization (*Sec*) is introduced as a bank's outstanding balance of securitized assets scaled by total assets. If the credit risk exposure arising from the securitized pool makes banks more risk-averse and motivates them to shift their portfolios towards assets of lower credit risk, there should be a negative association between banks' outstanding securitization and credit risk taking.

Bank size (*Size*), measured as a natural logarithm of total assets, is included to capture its possible impact on bank risk taking through a number of channels, including

funding and risk management opportunities. For example, Loutskina (2005) notes that only the largest banks in the US can have a sufficient quantity and homogeneity of loans to access the securitization market independently of other financial intermediaries.¹⁷ Therefore, given better access to external funds and the credit risk transfer market for large banks, one could expect a positive relation between the bank size and its propensity to engage in high risk/return activities.

The vector Z describes additional balance sheet and income statement characteristics of each bank which are introduced into the model to control for their possible impact on bank risk taking. From the balance sheet, Z includes loan ratio and capital ratio. Loan ratio (*Loan*) is measured as loans scaled by total assets and reflects the size of a bank's loan portfolio. Considering loans as the bank's major high risk assets, a bank with a greater loan portfolio is expected to be more risk-averse.

Bank capital (*Cap*) is measured as the ratio of equity capital to total assets. Considering capital as a "buffer of uninsured private funds to absorb portfolio losses" (Avery and Berger, 1990) yields two views on the nature of the relationship between bank capital and risk taking. On the one hand, diversified owners which do not have a significant fraction of their wealth placed in the bank might tend to advocate more risk taking after collecting funds from bondholders and depositors (Laeven and Levine, 2009; Esty, 1998).¹⁸ On the other hand, managers with bank-specific human capital and private benefits of control might be expected to behave in a risk-averse rather than value maximizing way (Demsetz and Lehn, 1985). As argued by Saunders *et al.* (1990) and Demsetz *et al.* (1996), managerial ownership should also be taken into account as managers' incentives to engage in risk taking increase along with their shareholdings. However, Anderson and Fraser (2000) show that for US bank holding companies managerial shareholdings and risk taking became inversely related in the early 1990s

following additional regulations (i.e., risk-adjusted deposit insurance premium). Therefore we expect a negative coefficient on the capital ratio variable.

From the income statement we include return on assets (*ROA*) and the charge-off ratio (*ChOff*) to account for the possible impact of present performance of a bank on its incentive to take on new risks. Particularly, one could argue that poor-performing banks (i.e., ones with a low return on their assets) might pursue risky activities to re-establish profitability. Following this argument, we expect a negative correlation between bank profitability and risk. A negative relationship could also be expected between the charge-off ratio and risk taking. The charge-off ratio reflects the asset quality of a loan portfolio. Low quality loans in a preceding quarter (i.e., as evidenced by a high charge-off ratio) should discourage the bank manager from taking on extra risk in the following quarter and motivate investing in low risk/secure return assets.

5 Empirical Results and Robustness Tests

5.1 Empirical Results

We report our results in Table 3. The regression analysis is based on the sample of securitizers which contains 5,067 observations for 230 BHCs; however, the second quarter 2001 observations are lost due to differencing and lagging the model variables, which yields 4,837 bank-quarters in the final regression data set. Each regression uses bank fixed effects with standard errors clustered at the BHC level (reported in parentheses). Quarterly dummies are incorporated in all of the regressions, but are not reported in the table.

The parameter estimate of most interest in terms of this study is that on securitization. The coefficient on securitization is found to be negative and significant at the 1% level. In other words, a greater outstanding balance of securitization is associated with banks choosing to invest in assets with lower credit risk. This evidence supports the

proposed hypothesis that securitization should have a negative effect on risk-taking behavior of the issuing bank as a result of credit exposure arising from the securitized pool.

Further examination of the results reported in Table 3 reveals that most of the control variables that are included in the model are statistically significant and have the expected signs. Beginning with bank size, the evidence suggests that larger banks tend to pursue higher risk activities. This is consistent with prior empirical studies and particularly could be linked to the size-related diversification effect described by Demsetz and Strahan (1997). The parameter estimate on the loan ratio reflects a significant negative impact of the size of the loan portfolio on bank risk taking. Not surprisingly, a greater amount of loans and therefore higher on-balance-sheet credit risk exposure makes banks more risk-averse. Equity capital has the expected negative effect on bank risk taking; however it is not statistically significant. The link between bank performance measures and risk taking is negative, as expected, and is statistically significant for the charge-off ratio. This shows that the current performance of a bank influences its risk-taking behavior. In particular, a bank with a lower quality loan portfolio, captured by a higher charge-off ratio, is more risk-averse.

The result of a significant negative effect of securitization on bank credit risk taking discussed above is derived using a broad category of securitization which includes different classes of underlying assets. To examine the impact of securitization in more detail, we decompose the aggregate measure of bank securitization activities into seven categories according to the type of assets securitized, and these are: (i) mortgages; (ii) home equity lines of credit; (iii) credit card receivables; (iv) auto loans; (v) other consumer loans; (vi) commercial and industrial loans; and (vii) all other loans and leases. We re-estimate Equation (1) using the outstanding amount of securitized assets scaled by total

assets for each of the above loan types. The results of the regressions are presented in Table 4; in each asset-specific regression a bank is included in the sample only for the quarter it securitizes according asset type.

Examining securitizations by the underlying asset type shows that they differ in their effect on the risk-taking behavior of banks. In particular, the results suggest that securitizations of mortgages and home equity lines of credit have a negative and statistically significant effect on bank credit risk taking; among these, credit risk taking is associated most negatively with securitized home equity lines of credit. Similarly, the effect of securitized credit card receivables, auto loans, other consumer loans, and commercial and industrial loans is negative, however not statistically significant. In contrast, the parameter estimate for securitizations of all other loans and leases is found to be positive, but insignificant statistically.

5.2 Robustness Tests

To verify the evidence presented above of a negative correlation between the outstanding securitization and credit risk taking, we perform a number of robustness tests that either examine sub-samples of the data or use alternative data definitions. Table 5 reports the results, where the first column repeats the estimates for the full sample for ease of comparison.

One possible concern is that the results might differ across banks of different size. To examine this argument, we split the sample into two sub-samples: small banks and large banks. Following Loutskina (2005), we assign a bank-quarter to a group of small banks if its size is in the bottom 75% of the size distribution, and to the group of large banks if size is in the top 10% of the size distribution. The sub-samples contain 3,621 and 486 bank-quarters, accordingly. Beginning with the small banks, the coefficient on securitization changes very little remaining negative and statistically significant. For the

large banks the coefficient remains negative; however it is four times larger than that for the full sample and not statistically significant.

A second possible concern is that the results might be affected by the onset of the US subprime mortgage crisis. To address this concern, we drop the 2007-year observations and re-estimate the regression for the 4,271 observations from 2001:Q2 to 2006:Q4. The results remain qualitatively unchanged.

A third concern is that the risk-weighted assets to total assets ratio might be inefficient in capturing the true credit risk position of a bank. As suggested by the capital arbitrage hypothesis, banks might shift towards riskier assets within regulatory risk bands. To test this argument, we use a ratio of non-performing assets to total assets (*NPATA*) as a measure of bank credit risk; this should reflect the true riskiness of a bank's portfolio given its backward-looking aspect.¹⁹ The results remain unchanged indicating a negative relation between securitization and the non-performing assets to total assets ratio and therefore confirms our finding that securitization leads to banks choosing portfolios of lower credit risk.

Finally, we test the proposed hypothesis that the negative relationship between outstanding securitization and credit risk taking is a result of the credit risk exposure arising from the securitized assets through recourse. As discussed earlier, recourse can be provided explicitly and/or implicitly. The implicit nature of the latter eliminates the possibility of its identification and, therefore, measuring its magnitude; however, the explicit recourse is reported by banks and therefore can be tested. In particular, we use a ratio of credit enhancements provided by the originating bank to securitization structures (i.e., a sum of credit enhancing interest-only strips, subordinated securities, and standby letters of credit) scaled by bank's total assets as a proxy for the credit exposure arising from the securitized portfolio. We re-estimate the main regression substituting the credit exposure

proxy for the outstanding securitization. The results show that the credit exposure has a negative and statistically significant impact on bank risk taking and therefore provides evidence for the proposed hypothesis.

6 Conclusions

The empirical results indicate firstly a significant negative impact of securitization on bank credit risk taking, suggesting that banks with a greater amount of assets securitized are more risk-averse in their activities. Second, examining securitization by the type of underlying assets suggests that the negative relationship between securitization and risk taking is primarily driven by securitizations of mortgages and home equity lines of credit; among these, credit risk taking is associated most negatively with securitized home equity lines of credit. Securitizations of all other types of assets seem to have no significant impact on bank credit-risk taking behavior.

We explain the finding of banks with a greater amount of assets securitized choosing portfolios of lower credit risk by the “recourse hypothesis”. This arises because issuing banks commonly provide recourse, explicitly and/or implicitly, in securitization transactions. The variation in the effect of securitization across different underlying asset classes provides further support for the proposed recourse hypothesis. In particular, as suggested by Chen *et al.* (2008), banks are likely to retain less risk, through both contractual and non-contractual arrangements, in mortgage-backed securitizations due to relatively low and easy externally verifiable credit risk of mortgage loans. This could explain mortgage securitizations having a smaller impact on the risk-aversion of the issuers compared to securitizations of home equity lines of credit. Additionally, mortgages are close-ended loans as opposed to revolving loans such as home equity lines of credit, which makes securitizations of the latter more implicit recourse requiring (Higgins and Mason, 2004; Chen *et al.*, 2008).

Taken as a whole, securitization activities are found to have a negative impact on the credit-risk taking behavior of banks. However, if the proposed recourse hypothesis is correct, the credit risk-reducing effect of securitization might be offset by banks' greater risk arising from the securitized pool. Therefore, the net impact of securitization on the riskiness of issuing banks is ambiguous and will depend on the structure of transactions, in particular, on the relative magnitude of credit support provided by banks. This leads us to suggest that banks view securitization as a financing rather than a risk management mechanism.

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Table 1. Summary Statistics for All Sample Banks and Univariate Tests of Differences in Characteristics between Securitizers and Non-Securitizers ²⁰

Variable	All Banks			Securitizers			Non-Securitizers			Difference in Means (abs) (%)	p-values	
	N	Mean	StD	N	Mean	StD	N	Mean	StD			
Balance Sheet Structure												
Total Assets (\$ billions)	2190	5.254	52.286	230	40.961	156.486	1960	1.064	5.001	39.897	3749.7%	0.000
Liquidity Ratio	2190	0.263	0.123	230	0.247	0.111	1960	0.265	0.124	-0.018	-6.8%	0.029
Loan Ratio	2190	0.664	0.125	230	0.660	0.123	1960	0.665	0.125	-0.005	-0.8%	0.577
Deposits/Assets Ratio	2190	0.681	0.088	230	0.621	0.124	1960	0.688	0.079	-0.067	-9.7%	0.000
Loans/Deposits Ratio	2190	0.999	0.289	230	1.122	0.380	1960	0.984	0.273	0.138	14.0%	0.000
Equity/Assets Ratio	2190	0.091	0.032	230	0.092	0.036	1960	0.091	0.032	0.001	1.1%	0.588
Loan Portfolio												
Real Estate Loan Ratio	2190	0.708	0.151	230	0.674	0.174	1960	0.712	0.148	-0.038	-5.3%	0.002
C&I Loan Ratio	2190	0.160	0.095	230	0.165	0.086	1960	0.159	0.095	0.006	3.8%	0.373
Consumer Loan Ratio	2190	0.080	0.085	230	0.096	0.115	1960	0.078	0.081	0.018	23.1%	0.018
Other Loan Ratio	2190	0.053	0.081	230	0.065	0.099	1960	0.051	0.079	0.014	27.5%	0.042
Loan HHI	2190	0.585	0.150	230	0.560	0.156	1960	0.588	0.150	-0.028	-4.8%	0.009
Regulatory Capital												
Tier I Leverage Ratio	2190	9.324	3.822	230	9.274	7.506	1960	9.330	3.120	-0.056	-0.6%	0.910
Tier I Risk-Based Capital Ratio	2190	13.327	6.636	230	12.743	12.168	1960	13.395	5.644	-0.652	-4.9%	0.423
Total Risk-Based Capital Ratio	2190	14.836	6.943	230	14.612	12.742	1960	14.862	5.906	-0.250	-1.7%	0.769
Risk Characteristics												
Credit Risk	2190	0.712	0.118	230	0.728	0.137	1960	0.710	0.115	0.018	2.5%	0.054
Non-Performing Loan Ratio	2190	0.009	0.008	230	0.010	0.007	1960	0.009	0.008	0.001	11.1%	0.038
Charge-Off Ratio	2190	0.003	0.007	230	0.005	0.012	1960	0.003	0.006	0.002	66.7%	0.017
Loan Loss Provision Ratio	2190	0.004	0.007	230	0.006	0.014	1960	0.004	0.005	0.002	50.0%	0.050
Operating performance												
Return on Assets	2190	0.011	0.007	230	0.012	0.013	1960	0.011	0.005	0.001	9.1%	0.076
Return on Equity	2190	0.124	0.076	230	0.123	0.126	1960	0.124	0.068	-0.001	-0.8%	0.970
Revenue HHI	2190	0.697	0.094	230	0.644	0.098	1960	0.703	0.092	-0.059	-8.4%	0.000
Interest Income/ Net Operating Revenue	2190	0.792	0.108	230	0.713	0.154	1960	0.801	0.097	-0.088	-11.0%	0.000
Securitization Activity												
Securitized Assets/Loans Ratio				230	0.144	0.515						
Securitized Assets/Assets Ratio				230	0.084	0.299						
Credit Enhancements/Securitized Assets Ratio				196	0.068	0.190						
Credit Enhancements/Assets				230	0.003	0.010						

Note: The table presents descriptive statistics for (i) all BHCs (2,190 banks), (ii) securitizers (230 banks), and (iii) non-securitizers (1,960 banks). *Mean* and *Std Dev* stand for the cross-sectional mean and standard deviation values of the individual bank time-series averages, accordingly. The last three columns report the comparison analysis of bank-specific characteristics between securitizers and non-securitizers. *Difference in Means* is calculated as the difference between securitizers' and non-securitizers' means, in absolute (*abs*) and percentage (%) values, with the p-values of t-tests on the equality of means reported in the last column.

Table 2. Definition of Model Variables

Variable	Definition	Construction	Expected Sign
CrR	Bank Credit Risk	Risk-Weighted Assets/Total Assets	Dependent Variable
Sec	Securitization	Outstanding Securitized Assets/ Total Assets	Negative
Size	Bank Size	Ln (Total Assets)	Positive
Loan	Loan Ratio	Loans /Total Assets	Negative
Cap	Capital Ratio	Equity Capital/Total Assets	Negative
ROA	Return on Assets	Net Income/Total Assets	Negative
ChOff	Charge-Off Ratio	Net Charge-Offs/Loans	Negative
GDPG	GDP Growth	GDP Real Growth Rate	

Note: This table presents definition, construction and expected signs on the variables used in this study for the regression of bank credit risk taking. The bank-level balance sheet data are collected from the Federal Reserve's Y-9C reports (See Appendix 1 for details).

Table 3. Determinants of Bank Credit Risk Taking

	Model 1	Model 2	Model 3
Securitization	-0.006 (0.001)***	-0.006 (0.001)***	-0.004 (0.001)***
Size		0.005 -0.004	0.006 (0.004)*
Loan			-0.118 (0.014)***
Capital			-0.01 -0.071
ROA			-0.027 -0.075
Charge-Off			-0.153 (0.092)*
GDPG	0.001 (0.000)***	0.001 (0.000)***	0.000 0.000
Constant	-0.001 -0.002	-0.072 -0.056	-0.015 -0.051
Observations	4837	4837	4837
Number of banks	230	230	230
Adjusted R-squared	0.02	0.02	0.06

Note: The table presents the results of the regression analysis where the dependent variable is the change in credit risk of bank portfolio measured as a change in the risk-weighted assets to total assets ratio ($\Delta RWATA$). The independent variables are: (i) securitization ratio; (ii) size; (iii) loan ratio; (iv) equity capital ratio; (v) return on assets; (vi) charge-off ratio; (vii) GDP real growth (see Table 2 for definitions of the variables and the expected signs). Balance sheet measures used are lagged one quarter. The columns represent three specifications of the regression model with Model 1 and Model 2 using a reduced form of the basic equation (1). Fixed effects regressions are run for the full sample of securitizers covering the period from 2001:Q2 to 2007:Q4. Quarter dummies are incorporated in all regressions (not reported). Robust standard errors reported in parentheses are corrected for clustering at the BHC-level. *, **, *** indicate significance at 10%, 5% and 1% levels, respectively.

Table 4. Testing Securitization by Asset Type

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Securitization	-0.004 (0.001)***							
Mortgages		-0.005 (0.003)*						
Home Equity Lines of Credit			-0.419 (0.111)***					
Credit Card Receivables				-0.017 -0.053				
Auto Loans					-0.045 -0.070			
Other Consumer Loans						-0.146 -0.089		
C&I loans							-0.235 -0.192	
Other Loans and Leases								0.036 -0.061
Size	0.006 (0.004)*	0.007 -0.006	0.040 (0.018)**	0.023 -0.018	0.037 (0.019)*	0.039 (0.014)***	0.038 (0.021)*	0.020 (0.011)*
Loan	-0.118 (0.014)***	-0.123 (0.025)***	-0.180 (0.042)***	-0.028 -0.082	-0.133 (0.046)***	-0.103 (0.049)**	-0.225 (0.055)***	-0.214 (0.039)***
Capital	-0.010 -0.071	-0.238 (0.075)***	-0.305 -0.201	-0.644 (0.339)*	0.327 (0.113)***	-0.313 -0.184	-0.190 -0.165	-0.237 (0.110)**
ROA	-0.027 -0.075	0.307 -0.189	0.059 -0.598	0.226 -0.355	-0.146 (0.063)**	-0.014 -0.594	-0.239 -0.533	-0.040 -0.455
Charge-Off	-0.153 (0.092)*	-0.014 -0.477	0.429 -0.890	-0.545 -0.354	-0.376 -0.337	-0.044 -0.432	-0.406 -0.531	0.134 -0.488
GDPG	0.000 0.000	0.001 -0.001	0.003 -0.002	0.002 -0.002	0.000 -0.002	0.000 -0.001	-0.001 -0.001	0.001 -0.001
Constant	-0.015 -0.051	-0.008 -0.088	-0.601 (0.317)*	-0.331 -0.328	-0.619 (0.336)*	-0.653 (0.253)**	-0.506 -0.352	-0.193 -0.186
Observations	4837	1678	336	351	424	358	312	538
Number of banks	230	164	27	36	34	23	30	44
Adjusted R-squared	0.06	0.06	0.14	0.11	0.15	0.11	0.15	0.14

Note: The table presents the results of regressions of bank credit risk taking ($\Delta RWATA$) on securitization activities broken down by the type of assets securitized with the first column reporting the basic regression model. Columns 2-8 represent seven specifications of the basic regression model using the following categories of securitized assets: (i) mortgages; (ii) home equity lines of credit; (iii) credit card receivables; (iv) auto loans; (v) other consumer loans; (vi) C&I, or commercial and industrial loans; (vii) all other loans and leases. The sample covers the period from 2001:Q2 to 2007:Q4; quarter dummies are incorporated in all regressions (not reported). Robust standard errors reported in parentheses are corrected for clustering at the BHC-level. *, **, *** indicate significance at 10%, 5% and 1% levels, respectively.

Table 5. Robustness Tests for the Determinants of Bank Credit Risk Taking

	(1) Δ RWATA			2001-2006	(2) Δ NPATA	(3) Δ RWATA
	All Banks	Small	Large		All Banks	All Banks
Securitization	-0.0036 (0.0009)***	-0.003 (0.0007)***	-0.015 -0.011	-0.0036 (0.0010)***	-0.0002 (0.0001)**	
Credit						-0.49 (0.1298)***
Size	0.0065 (0.0036)*	0.0041 -0.0035	0.0288 (0.0089)***	0.0076 (0.0043)*	0.001 (0.0003)***	0.005 -0.0037
Loan	-0.1178 (0.0141)***	-0.1297 (0.0163)***	-0.0928 (0.0277)***	-0.135 (0.0171)***	0.0019 -0.0015	-0.1538 (0.0159)***
Capital	-0.0097 -0.0711	0.0214 -0.069	-0.4945 (0.1351)***	0.0183 -0.0821	-0.005 -0.0049	-0.1079 (0.0380)***
ROA	-0.0268 -0.0751	-0.0857 -0.0683	0.4177 -0.5776	-0.0122 -0.0882	-0.0443 -0.03	0.1239 -0.1019
Charge-Off	-0.1534 (0.0923)*	-0.1032 -0.0892	-0.281 -0.4573	-0.1143 -0.1032	-0.01 -0.0164	-0.6124 (0.1263)***
GDPG	0.0005 -0.0004	0.0000 -0.0004	0.0010 -0.0011	0.0003 -0.0004	-0.0001 (0.0000)***	-0.0003 -0.0004
Constant	-0.0151 -0.0514	0.0333 -0.0492	-0.4529 (0.1571)***	-0.0227 -0.0608	-0.0143 (0.0046)***	0.0446 -0.0549
Observations	4837	3621	486	4271	4837	3483
Number of banks	230	181	25	230	230	229
Adjusted R-squared	0.056	0.06	0.12	0.064	0.039	0.068

Note: Fixed effects regressions of bank risk taking on the following regressors: (i) securitization ratio; (ii) size; (iii) loan ratio; (iv) equity capital ratio; (v) return on assets; (vi) charge-off ratio; (vii) GDP real growth; and (viii) quarter dummies (not reported). All the balance sheet measures are lagged one quarter. Column 1 represents four specifications of the basic model based on: (i) full sample; (ii) sub-sample of small banks; (iii) sub-sample of large banks; and (iv) sub-period 2001:Q2-2006:Q4. Column 2 uses the change in the non-performing assets to total assets ratio (Δ NPATA) as the dependent variable. Column 3 uses a credit exposure proxy as a substitute for the securitization ratio in the basic regression model. Robust standard errors reported in parentheses are corrected for clustering at the BHC-level. *, **, *** indicate significance at 10%, 5% and 1% levels, respectively.

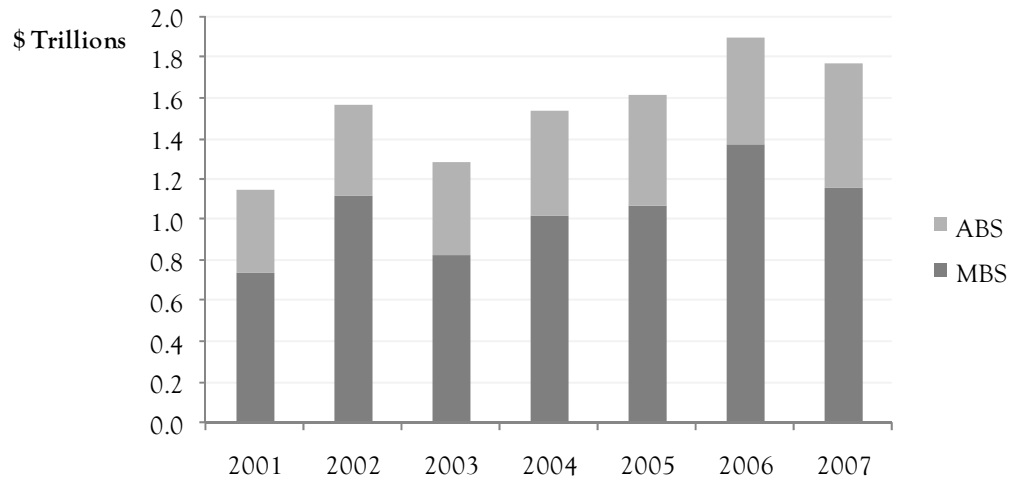


Figure 1. Yearly Values of Securitized Assets

Note: The figure presents the total balance of outstanding securitization for the sample BHCs for year-ends 2001-2007. Total value of assets securitized is presented as the sum of MBS and ABS values; *MBS* stands for the value of mortgages securitized, while *ABS* indicates the value of receivables other than mortgage loans, such as credit card receivables, auto loans, commercial and industrial loans, and home equity lines of credit. The values are in US\$ trillions.

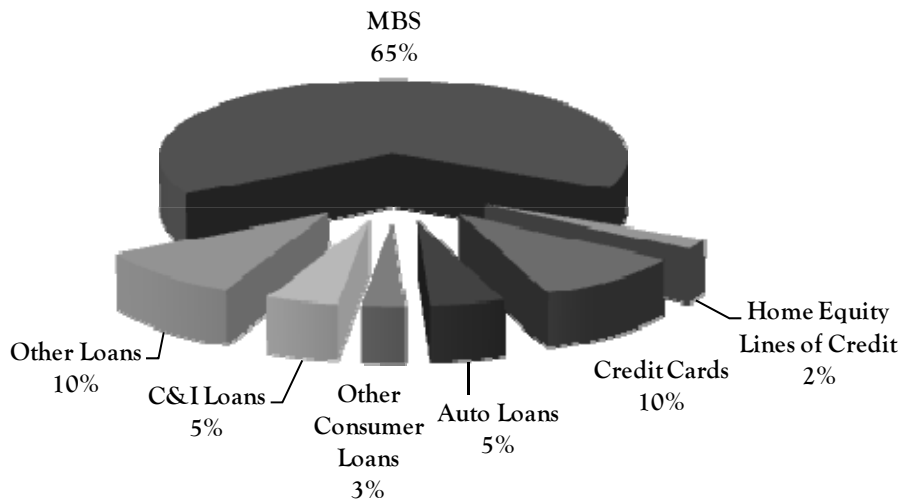


Figure 2. Securitization Breakdown by Asset Type

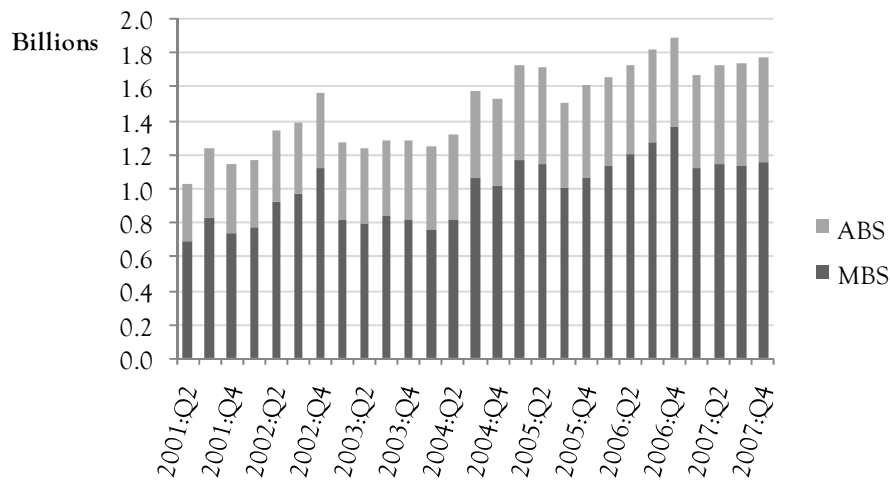
Note: The figure illustrates the percentage distribution of securitization by the type of assets securitized derived from the mean values for the sample BHCs. The asset categories are: (i) mortgages (MBS); (ii) home equity lines of credit; (iii) credit cards; (iv) auto loans; (v) other consumer loans; (vi) commercial and industrial (C&I) loans; and (vii) all other loans and leases.

Appendix 1. Variable Names and Construction

Variable	FR Y-9C Data Item
Balance Sheet Structure	
Total Assets	BHCK2170
Liquidity Ratio	$(\text{BHCK0081} + \text{BHCK0071} + \text{BHCK1754} + \text{BHCK1773})/\text{BHCK2170}$
Loan Ratio	$\text{BHCK 2122}/\text{BHCK2170}$
Deposits/Assets Ratio	$(\text{BHCK3517} + \text{BHCK3404})/\text{BHCK3368}$
Deposits/Loans Ratio	$(\text{BHCK3517} + \text{BHCK3404})/\text{BHCK3516}$
Equity-to-Assets Ratio	$\text{BHCK3210}/\text{BHCK2170}$
Loan Portfolio Composition	
Real Estate Loans ratio	$\text{BHCK1410}/(\text{BHCK2122} + \text{BHCK2123})$
C&I Loans Ratio	$(\text{BHCK1590} + \text{BHCK1766})/(\text{BHCK2122} + \text{BHCK2123})$
Consumer Loans Ratio	$\text{BHCK1975}/(\text{BHCK2122} + \text{BHCK2123})$
Other Loans Ratio	$(\text{BHCK1400} - \text{BHCK1410} - \text{BHCK1766} - \text{BHCK1590} - \text{BHCK1975})/(\text{BHCK2122} + \text{BHCK2123})$
Loan HHI	$(\text{BHCK1410}/(\text{BHCK2122} + \text{BHCK2123}))^2 + (\text{BHCK1590} + \text{BHCK1766}/(\text{BHCK2122} + \text{BHCK2123}))^2 + (\text{BHCK1975}/(\text{BHCK2122} + \text{BHCK2123}))^2 + ((\text{BHCK1400} - \text{BHCK1410} - \text{BHCK1766} - \text{BHCK1590} - \text{BHCK1975})/(\text{BHCK2122} + \text{BHCK2123}))^2$
Regulatory Capital	
Tier I Leverage Ratio	BHCK7204
Tier I Risk-Based Capital Ratio	BHCK7206
Total Risk-Based Capital Ratio	BHCK7205
Risk Characteristics	
NPL Ratio	$(\text{BHCK5525} + \text{BHCK5526} - \text{BHCK3506} - \text{BHCK3507})/\text{BHCK3516}$
NPA Ratio	$(\text{BHCK5525} + \text{BHCK5526})/\text{BHCK2170}$
RWATA Ratio	$\text{BHCKA223}/\text{BHCK2170}$
Charge-Off Ratio	$(\text{BHCK4635} - \text{BHCK4605})/\text{BHCK3516}$
Loan Loss Provision Ratio	$\text{BHCK4230}/\text{BHCK3516}$
Operating Performance	
Return on Assets	$\text{BHCK4340}/\text{BHCK3368}$
Return on Equity	$\text{BHCK4340}/\text{BHCK3519}$
Interest Income/Net Operating Revenue	$\text{BHCK4074}/(\text{BHCK4074} + \text{BHCK4079})$
Noninterest Income/Net Operating Revenue	$\text{BHCK4079}/(\text{BHCK4074} + \text{BHCK4079})$
Revenue HHI	$(\text{BHCK4074}/(\text{BHCK4074} + \text{BHCK4079}))^2 + (\text{BHCK4079}/(\text{BHCK4074} + \text{BHCK4079}))^2$

Note: Variables used in the study. Data items are taken from FR Y-9C forms.

Appendix 2. Quarterly Values of Outstanding Securitization



Note: This figure presents the quarterly outstanding balances of assets securitized by the sample banks over the 2001:Q2-2007:Q4 period. Total value of assets securitized is presented as the sum of MBS and ABS values; *MBS* presents the value of mortgages securitized, while *ABS* indicates the value of receivables other than mortgage loans, such as credit card receivables, auto loans, commercial and industrial loans, and home equity lines of credit. The values are in US\$ trillions.

Endnotes

- ¹ Securitization has been widely used as a funding, risk management and performance improvement tool by banks and other institutions over the last two decades. But securitization experienced a spectacular growth during the decade prior to the financial crisis. The market for mortgage-backed securities increased from \$2.49 trillion in 1996 to \$8.9 trillion outstanding at year-end 2008. The outstanding volume of asset-backed securities reached \$2.67 trillion at year-end 2008 from \$0.4 trillion in 1996 (Source: Securities Industry and Financial Markets Association).
- ² See for example Dionne and Harchaoui (2003), Uzun and Webb (2007), Franke and Krahen (2005), and Haensel and Krahen (2007).
- ³ SR 02-15 “Implicit Recourse Provided to Asset Securitizations” (Federal Reserve, 2002). For discussion of implicit recourse also see Higgins and Mason (2003), Gorton and Souleles (2005), Vermilyea *et al.* (2008).
- ⁴ Aggarwal and Jacque (2001); Thomas and Wang (2004)
- ⁵ The Schedule HC-S of Y-9C reports the breakdown of securitization into seven categories: 1-4 Family Residential Loans; Home Equity Lines; Credit Card Receivables; Auto Loans; Other Consumer Loans; Commercial and Industrial Loans; and All Other Loans, All Leases, and All Other Assets. Securitizations are reported as the outstanding principal balance of the corresponding assets sold and securitized with servicing retained or with recourse or other seller-provided credit enhancements.
- ⁶ The construction of the variables is described in detail in Appendix 1.
- ⁷ Minton *et al.* (2004); Bannier and Haensel (2007); Martin-Oliver and Saurina (2007); Uzun and Webb (2007); Jiangli and Pritsker (2008); Minton *et al.* (2008)
- ⁸ Herfindahl-Hirschman Index is calculated using four loan categories: (i) real estate loans, (ii) commercial and industrial loans, (iii) consumer loans, and (iv) other loans; a higher value indicates higher loan portfolio concentration.
- ⁹ Minton *et al.* (2008) find similar evidence.
- ¹⁰ Non-performing loans are defined as loans past due 90 days or more and still accruing interest, and nonaccrual loans.
- ¹¹ Net charge-offs are defined as charge-offs minus recoveries.
- ¹² Jiangli and Pritsker (2008) suggest that this could reflect securitization and/or size effect in allowing banks to extend loans with higher expected losses.
- ¹³ Using US Bank Holding Company Data from 1999 to 2005, Minton *et al.* (2008) find that the net buyers of credit protection have dramatically more trading revenue than other banks.
- ¹⁴ See Appendix 2 for the quarterly values of outstanding securitization.
- ¹⁵ Under Basel I, banks assets and off-balance-sheet activities are allocated into four categories according to their credit risk: (i) assets with zero default risk (e.g., government securities, reserves); (ii) low-risk assets (e.g., interbank deposits); (iii) assets with medium default risk (e.g., mortgage loans), and (iv) high-risk assets (e.g., commercial loans). Each category is assigned a relative risk weight, ranging from 0 to 1. Therefore, a bank’s total risk-weighted assets (RWA) are derived as: $RWA = 0 * \text{Category I} + 0.2 * \text{Category II} + 0.5 * \text{Category III} + 1.0 * \text{Category IV}$.
- ¹⁶ The Federal Reserve Board Website www.federalreserve.gov/boarddocs/speeches/2007
- ¹⁷ A number of studies document that large banks are more likely to securitize assets (Karaoglu, 2005; Bannier and Haensel, 2007). Jiangli and Pritsker (2008) suggest that this may reflect economies of scale for large banks in underwriting and securitization, or diseconomies of scale in funding through deposits.
- ¹⁸ Stringent regulatory requirements might further contribute to the risk-taking incentives of owners and lead to them favoring riskier portfolios to compensate for the loss of utility (Koehn and Santomero, 1980; Buser *et al.*, 1981).
- ¹⁹ We use non-performing asset ratio (non-performing assets scaled by total assets) rather than non-performing loan ratio as we aim to test the change in the riskiness of bank’s total assets and not just loans. The former additionally incorporates non-performing debt securities and other assets. See Appendix 1 for details.
- ²⁰ In regulatory reporting forms income statement items are reported on a year-to-date basis. Following Cebenoyan and Strahan (2004), to make measures of risk and profitability more familiar (charge-off ratio, loan loss provision ratio, return on assets and equity), we annualize the quarterly flow variables by multiplying by four.